Climate Variability and Predictability (CVP)

Information Sheet 2009

Over the last several years there has been a growing recognition of the need to augment seasonal to interannual climate predictions and century-scale climate projections with decadal-scale climate predictions. The climate system is not changing in a simple linear fashion. Rather, climate system changes are a combination of natural climate variability and the response of the climate system to radiative forcing changes of both natural and anthropogenic origin. The interaction of natural variability and forced climate change has the potential to lead to abrupt climate change. The relative importance of natural variability becomes progressively greater on smaller spatial scales. Climate prediction on decadal scales requires the capability to predict both the natural variability of the climate system and its response to radiative forcing. The former is an initial value problem, in which the observed climate state is used as an initial condition for a climate prediction system.

There are prominent and important examples of this interplay between forced climate change and natural variability. As one example, there have been dramatic changes over the last decade in the characteristics of hurricane activity over the Atlantic, with associated impacts over North America. It is currently an unresolved issue whether these changing hurricane characteristics are due to human-induced climate change or are attributable to natural variability – or some combination thereof. The answer to this question has major implications for understanding the likely characteristics of future Atlantic hurricane activity. Similarly the last several years have seen significant drought over the western U.S. While drying in the southwestern U.S. is broadly consistent with model-based projections of the impact of global warming, it is an open question whether the current drought is a manifestation of forced climate change or natural variability. The answer to this question has major societal implications for large-scale water resources.

There are a number of significant research topics that must be addressed in order to develop a robust capability for decadal-scale climate predictions. While significant effort has gone into simulating the response of the climate system to radiative forcing changes on decadal and longer time scales, less effort has gone into attempting to predict the evolution of the climate system on decadal scales. Among the important research topics to address are the following:

(1) What are the physical mechanisms responsible for observed decadal scale climate variability? Increased understanding of these mechanisms is an important foundation for any predictive capability.

(2) What is the inherent predictability of the climate system on sub-decadal and longer timescales? This is oftentimes addressed through the use of climate models, although the robustness of this assessment depends on the fidelity of the model employed.

(3) What are the physical mechanisms that give rise to any such decadal scale

predictability? There is increasing evidence that any such predictability involves slowly varying ocean circulations and their interaction with the atmosphere.

(4) What are the required observing systems to most efficiently capture this decadal variability, both for the purpose of characterizing this variability and for initializing prediction models?

(5) Suitable numerical assimilation schemes are needed to translate required observations into a form suitable for initializing models for decadal-scale predictions.

(6) Finally, it is unclear whether the current generation of climate models is capable of realizing any decadal-scale predictability that does exist in the climate system.

We seek research proposals that address the above questions and topics, with a very strong focus on decadal climate predictability over North America. Priority will be given to those proposals that have the greatest likelihood to contribute directly to NOAA's goal of developing a decadal climate prediction system. In this vein, proposed work that will lead directly to improved understanding of decadal climate predictability over North America, leading to an operational decadal climate predictive capability, will receive highest priority.